

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property  
Organization  
International Bureau



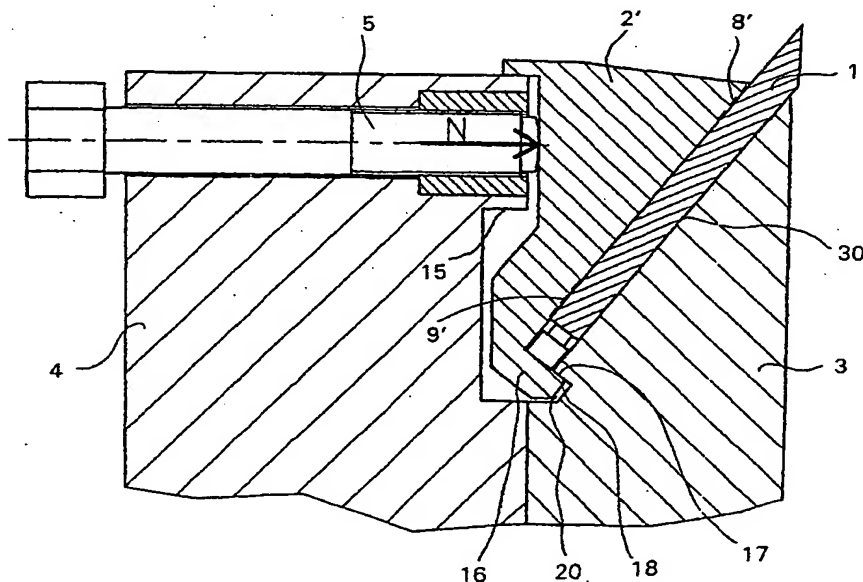
(43) International Publication Date  
8 January 2004 (08.01.2004)

PCT

(10) International Publication Number  
WO 2004/002698 A1

- (51) International Patent Classification<sup>7</sup>: B27L 11/00 (74) Agent: OY JALO ANT-WUORINEN AB; Iso Roobertinkatu 4-6 A, FIN-00120 Helsinki (FI).
- (21) International Application Number: PCT/FI2003/000495
- (22) International Filing Date: 18 June 2003 (18.06.2003)
- (25) Filing Language: Finnish
- (26) Publication Language: English
- (30) Priority Data: 20021248 26 June 2002 (26.06.2002) FI
- (81) Designated States (*national*): BR, CA, CN, CZ (utility model), CZ, EE (utility model), EE, FI (utility model), FI, ID, JP, LT, LV, NO, PL, RU, US.
- (84) Designated States (*regional*): European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR).
- (71) Applicant (*for all designated States except US*): METSO PAPER, INC. [FI/FI]; Fabianinkatu 9 A, FIN-00130 Helsinki (FI).
- Published: — with international search report.
- (72) Inventor; and
- (75) Inventor/Applicant (*for US only*): JONKKA, Arvo [FI/FI]; Mäntykatu 20, FIN-28430 Pori (FI).
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(54) Title: METHOD FOR CLAMPING A KNIFE IN A DISK CHIPPER AND A KNIFE CLAMP FOR A KNIFE ASSEMBLY



(57) Abstract: The invention concerns a method for clamping a knife (1) of a disc chipper, wherein the knife (1) is pressed from the knife disc (4) via knife clamp (2', 23) against a wear plate (3) in a diagonal position ( $\alpha$ ) with respect to the plane of the knife disc with a compressive force (N) substantially parallel with the axis of the knife disc. According to the invention, the compensating force of the force directed to the knife clamp, caused by the diagonal position ( $\alpha$ ) of the knife and transversal to the compressive force (N) is exerted to the wear plate.

BEST AVAILABLE COPY

WO 2004/002698 A1

5/10/03  
METHOD FOR CLAMPING A KNIFE IN A DISC CHIPPER AND A KNIFE CLAMP  
FOR A KNIFE ASSEMBLY

The present invention concerns a method for clamping a knife of a disc chipper against a wear plate by means of a knife press between the wear plate and the knife disc. The invention also concerns a knife clamp, that is pressed by a device supported from the knife disc and that is supported to the knife and the wear plate.

Disc chippers are generally used in the wood processing industry for chipping wood prior to the further processing. The rotating disc of a chipper is equipped with knives attached evenly distributed thereto cutting chips from a log against a counter knife. The knives are generally attached to the disc through separate knife presses that are locked in position generally by means of a compressive force provided by bolts. The knife press by means of which the knife is pressed in its position is in this publication referred to as knife clamp.

When attaching a knife in its position in the knife disc according to a method of prior art, the knife clamp and the knife are pressed with bolts against the wear plate. The method is described e.g. in the publication US 6,056,030. The bolts are parallel with the axis of the knife disc. The bolts have their support from the knife disc and move the knife clamp and the knife in the axial direction of the knife disc, away from the knife disc towards the inclined surface of the wear plate, against which the knife is positioned. This positioning surface of the knife in the wear plate deviates due to its inclination from the direction perpendicular to the pressing motion of the clamp, whereby the knife clamp and the knife are subject to forces from the wear plate, that tend to move the knife clamp aside from the direction of the desired pressing motion. Against this transversal motion the knife clamp is supported from the knife disc near the compressing bolt. A friction force is generated to the point of support resisting the movement of the knife clamp during the compressing process.

The method in accordance with the present invention is characterized in, that the point of support preventing the transversal movement of the knife clamp is positioned in the wear plate on the area of the plane between the knife and the knife clamp, said area facing the knife, whereby the transversal force required for attaching the knife increases the compressive force between the knife clamp and the knife. The knife clamp in accordance with the invention substantially takes the support of the knife clamp against the transversal move-

ment from the wear plate by means of a bracket of the knife clamp. Due to the method, the compressive force of the knife clamp can be provided also with other methods than bolt attachment, because a supporting surface of the knife disc under the knife clamp is not essential.

5 The invention and its details will now be described in more detail with reference to the enclosed drawings, where

Figure 1 shows a traditional knife assembly and knife clamp of a disc chipper,

Figure 2 shows the forces directed to the knife clamp,

Figure 3 shows a knife clamp according to the present invention,

10 Figure 4 shows forces directed to the knife clamp according to the present invention, and

Figure 5 shows a preferred construction according to the present invention.

Figure 1 shows a generally used knife assembly. Knife 1 is attached in its place by pressing the knife by means of a knife clamp 2 against a wear plate 3. Bolts for attaching the wear plate to the knife disc 4 is not shown in the figure. The knife clamp 2 is pressed in the direction of arrow N against the knife 1 by means of a bolt 5. Bolt 5 is supported from the knife disc 4 by means of a hardened threaded bushing 6. The surface 7 of the knife clamp placed against the knife 1 is formed slightly concave, so that the knife clamp is supported against the knife at points 8 and 9. Thus, the knife 1 has the best possible support from the knife clamp 2 despite of small inaccuracies in manufacturing. The most important thing is to have the knife supported in the best possible way near the point of the knife by means of surface 8.

It has been noticed in the practice that the point portion 11 of the wear plate 3 slightly yields due to the force N. Thus, also the knife 1 and the knife clamp 2 must turn from 0,2 to 0,3 mm at the point portion 12 thereof. Turning of the knife clamp and tensioning of the bolts 5 are contributed by the rounded ends 13 of the bolts.

Against the direction perpendicular to the pressing motion, the knife clamp is supported by means of the surface 14. The surface 14 is supported against the counter surface 15 in the knife disc and a friction force caused by the supporting force is generated between these surfaces.

During the chipping process the point 11 of the wear plate is in a small continuous bending motion and the size of said friction force varies continuously. In praxis this variation causes a pulsating effect to the compressive force of the point 8 of the knife clamp. Function of the knife clamp is to keep the knives firmly attached to the chipper and another  
5 main function is to maintain an adequate compressive force on the area of the point 8. Decreasing of said compressive force is substantially influenced not only by the bending of the wear plate but also the force turning the knife clamp caused by the compressive force between the surfaces 14 and 15, said force being dependent on the height  $h$  and the angle  $\alpha$  of the clamp, as shown in figure 1. The height of the clamp is dependent on the adequate  
10 stiffness of the clamp and the distance between the screws 5. Angle  $\alpha$  of the knife is in general about 36 - 40 degrees and it is influenced by the sharpening angle of the point of the knife.

Referring to figure 2, the arrows describe forces exerted by the knife clamp 2 to the other parts of the knife disc. For simplicity of the force figure, the concavity of the surface 7 of  
15 the knife clamp against the knife is not taken into account. The compressive force caused by the bolt is  $P_1$  ( $=N$ ). The correspondingly big supporting force  $P_1'$  exerted to the knife 1 is divided into component  $P_2$  effecting against the knife and component  $P_3+P_\mu$  effecting in the direction of the knife. Force  $P_3$  parallel with the surface of the knife, which is a residual force taking into account the friction force caused by  $P_2$ , tends to move the knife clamp  
20 from its place. The size of the force is dependent on the friction between the knife and the knife clamp. The surface of the knife clamp facing against the knife of the knife clamp is effected by the force  $P_3$  coming from the knife, and force  $P_3'$  affecting the knife disc is formed to the supporting surface 14. Forces  $P_{3\mu}'$  and  $P_+$  parallel with the surface 14 are formed thereby.

25 Force  $P_2$  effects in perpendicular direction to the surface of the knife and it is divided into counter forces  $P_4$  and  $P_5$ , which are located on their respective areas of influence 8 and 9. Most important is that the force  $P_4$  maintains adequate. Distance of the above mentioned pair of forces is  $c$  and the size of this distance varies to some extent according to inaccuracies of the surfaces of the knife 1 and the knife clamp 2. Force  $P_3$  moving aside the knife  
30 clamp from the direction of effect of force  $P_1$  gives a decreasing effect ( $P_4$ ) and an increas-

ing effect ( $P_5$ ) according to formula (b/c)  $P_3$  to the pare of forces  $P_4 - P_5$ . This results in additional need of force  $P_1$ , when a certain level of force  $P_4$  is needed.

A bigger height  $h$  (Fig. 1) also increases the dimension  $b$  and requires increasing of the clamping force  $P_1$ . Harmful effect of this problem increases during the operation of the chipper, whereby the vibration decreases the influence of the friction and the compressive force of the area 8 can decrease as much as 50 %. A minor effect increasing the force  $P_1$  comes from force  $P_+$  according to formula ( a/c)  $P_+$ . This increasing portion of the main force  $P_1$  ranges from 3 to 10 %. When the knife 1 gets narrower due wearing, the dimension  $a$  is 0 and there is no favourable effect  $P_+$ .

A knife clamp 2' according to the invention is shown in figure 3. The knife clamp 2' is supported against the perpendicular direction parallel with the compressive motion  $N$  by means of the surface 17 of the bracket 16. Otherwise the knife clamp 2' corresponds to that shown in figure 1. Counter surface for the bracket 16 is the surface 18 of the groove 20 in the wear plate 3. The system according to the present invention has that considerable benefit that no supporting surface 15 is needed and the knife clamp according to figure 3 can also be used with other attaching methods than bolts.

In the knife clamping system of figure 3 according to the present invention, the support of the transversal force effected by the clamping force  $N$  of the knife clamp has been moved over to the other side of the surface 30 between the knife 1 and the knife clamp 2' compared with the system shown in figure 1. The force pattern of the construction of figure 3 shown in figure 4 shows that correspondingly force  $P_3$  parallel with the surface of the knife as well as a corresponding supporting force  $P_3'$  are generated in this construction to the surface 17. The force increasing the force  $P_2$  against the knife can be calculated from the figure 4 by formula ( d/e )  $P_3'$ . As it is evident from said formula, that a long surface 7' against the knife is unfavourable with respect to the increasing of force  $P_2$ . A wide knife 1 according to figure 3, however, requires a wide knife clamp 2'.

The advantages of the present invention become evident from the construction in accordance with figure 5, where the knife 24 is led in position through the groove 25 by means of a projection 22 of the knife clamp 23. Turn knife 24 equipped with two points is much

narrower than the knife of figures 1 and 3 and requires thereby a better support. Thereby the supporting of the knife 24 is a much more demanding task and the knife clamp according to the invention and figure 5, where the relation of dimensions  $f/g$  is bigger than the relation  $d/e$  according to figure 3 is a suitable solution for this purpose. An adequate strength is also reached without any problems, because height  $h'$  does not matter.

A wide knife as shown in figure 3 requires two supporting regions 8' and 9' between the knife clamp and the knife. There the bracket 16 cannot be used for supporting the force  $P_2$ , because a three-point or three-area supporting is not successful due to fabrication inaccuracies. The knife clamp according to figure 5, instead, forms only one supporting area 28 against the knife from the bottom of the groove 25. Another balancing support is provided by the bottom surface 26 of the groove 20', against which the corresponding surface 21 of the bracket 16' is supported, whereby bracket 16' receives the force  $P_3'$  and a part of the force  $P_2$ . Thereby an adequate clamping of the knife can be achieved with a reasonable force  $N$ .

The arrangement in accordance with figure 5 has an additional advantage therein that the knife disc 4 has a surface 29 with no groove. This means considerable savings in costs of machining.

Oversized compressive forces require a large number of clamping screws and big forces result in durability problems of threads and bending of the wear plate 3 as well as in permanent deformation, which causes functional disturbances and need of changing components. By means of a method and a knife clamp in accordance with the present invention, the disadvantages mentioned above can be avoided.

Claims

1. A method for clamping a knife (1) of a disc chipper, wherein the knife is pressed from the knife disc (4) via knife clamp (2', 23) against a wear plate (3) in a diagonal position ( $\alpha$ ) with respect to the plane of the knife disc with a compressive force (N) substantially parallel with the axis of the knife disc, **characterized** in, that a compensating force of the force directed to the knife clamp, caused by the diagonal position ( $\alpha$ ) of the knife and transversal to the compressive force (N), is exerted to the wear plate.
2. A method in accordance with claim 1, **characterized** in, that the compensating force of the transversal force is exerted to the wear plate (3) in parallel direction with the knife (1), facing the wear plate with respect to the plane between the knife and the wear plate, whereby the compensating force brings about a moment that turns the knife clamp and increasing of the compressive force ( $P_4$ ) on the region (8) of the knife point.
3. A clamping arrangement for a knife of a disc chipper comprising a knife disc (4), a wear plate (3), a knife (1), compressing means (5) and a knife clamp (2' or 23), wherein a lateral force ( $P_3$ ) is generated, said force deviating by angle ( $\alpha$ ) from the perpendicular direction to the compressive force (N), **characterized** in that there is a bracket (16) in the knife clamp (2' or 23), the surface (17) of which receives the generated force ( $P_3$ ) by supporting itself against a surface (18) of the groove (20) of the wear plate (3).
4. A knife clamp (23) in accordance with claim 3, **characterized** in, that the upper surface (21) of the bracket (16') is supported to the bottom surface (26) of the groove (20') of the wear plate (3).
5. An assembly for clamping a knife (1) in accordance with claim 3 and 4, **characterized** in, that the knife clamp (23) comprises a projection (22) guiding the knife (24) from a groove (25).

1/5

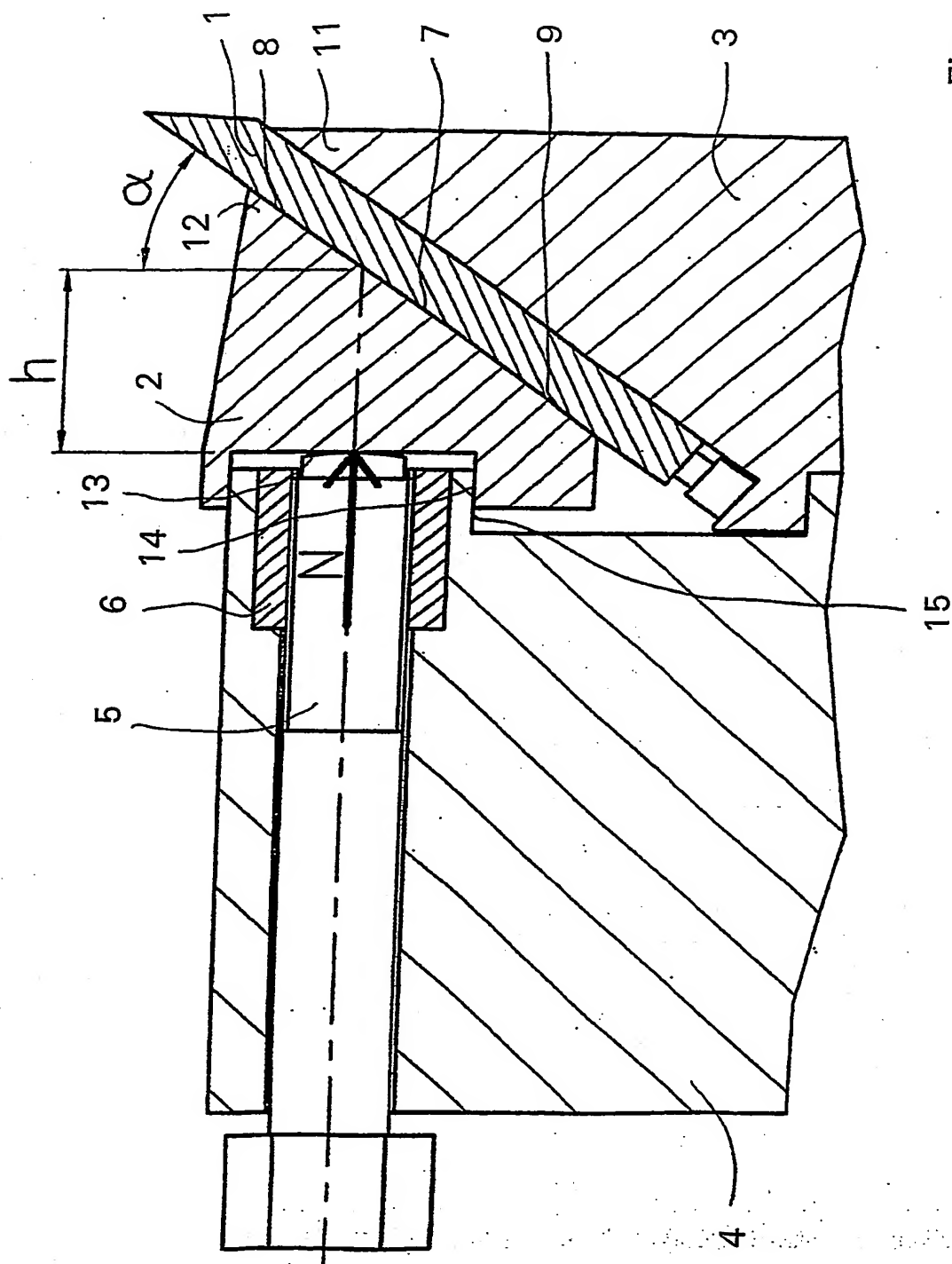


Fig. 1





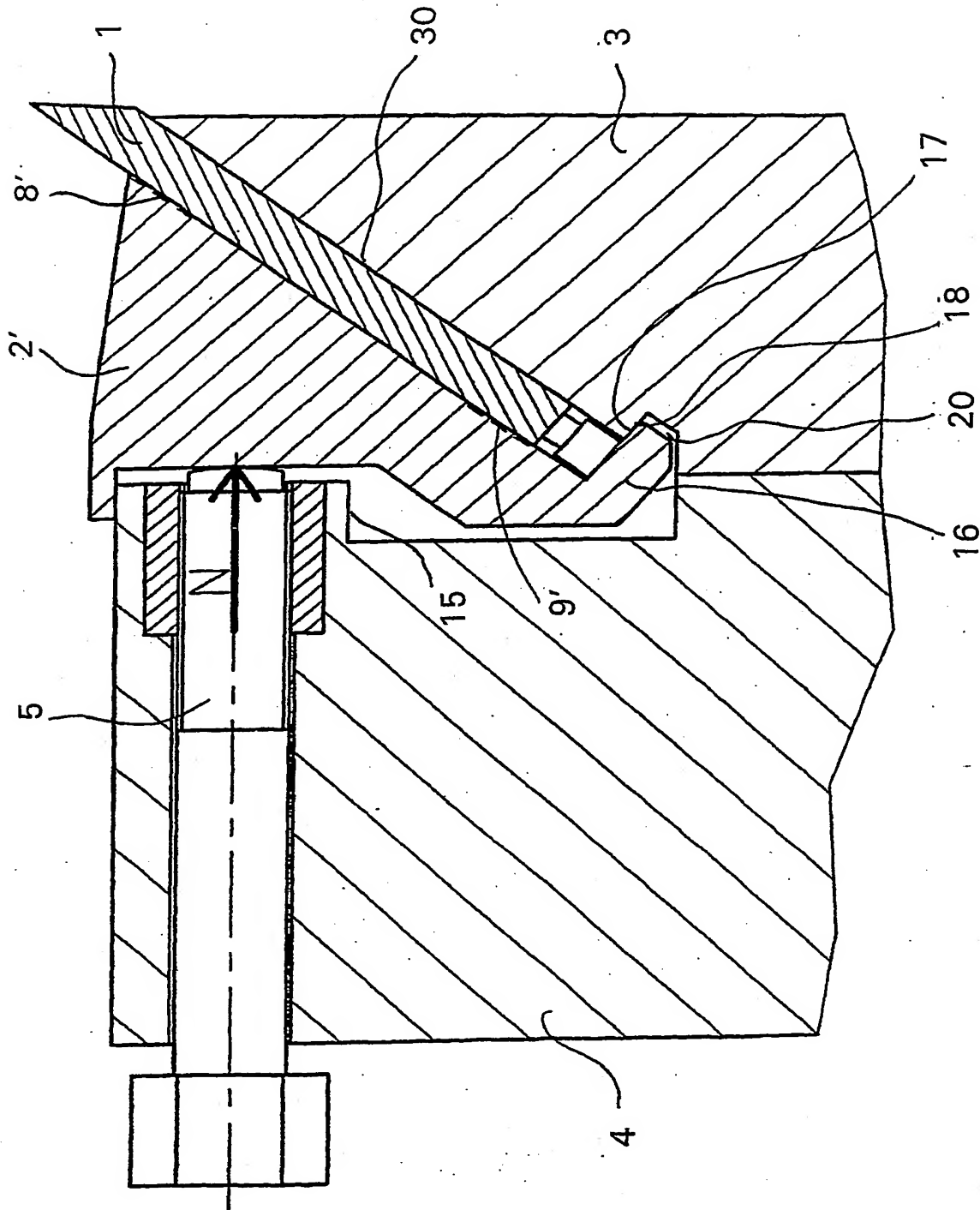


Fig. 3

4/5

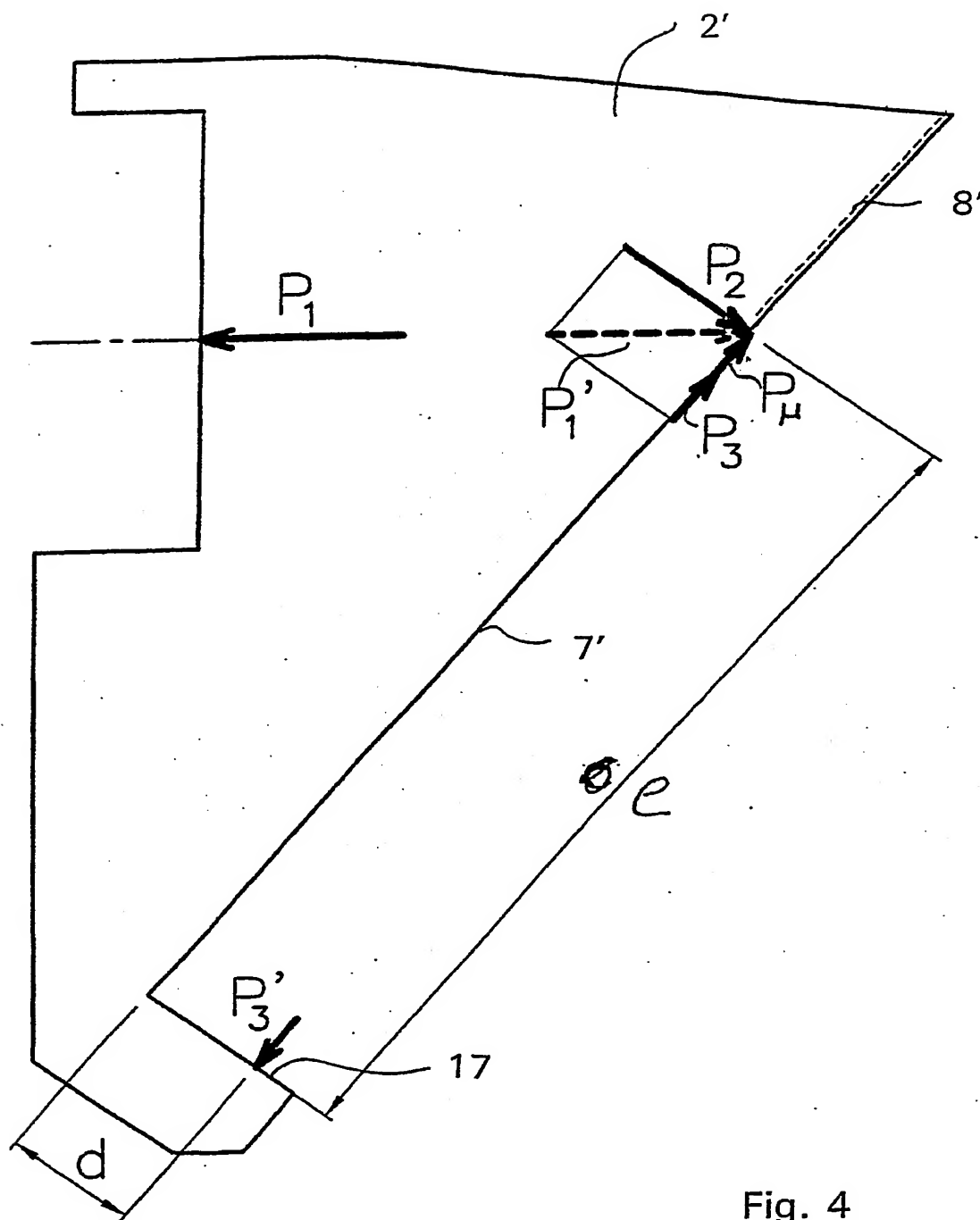
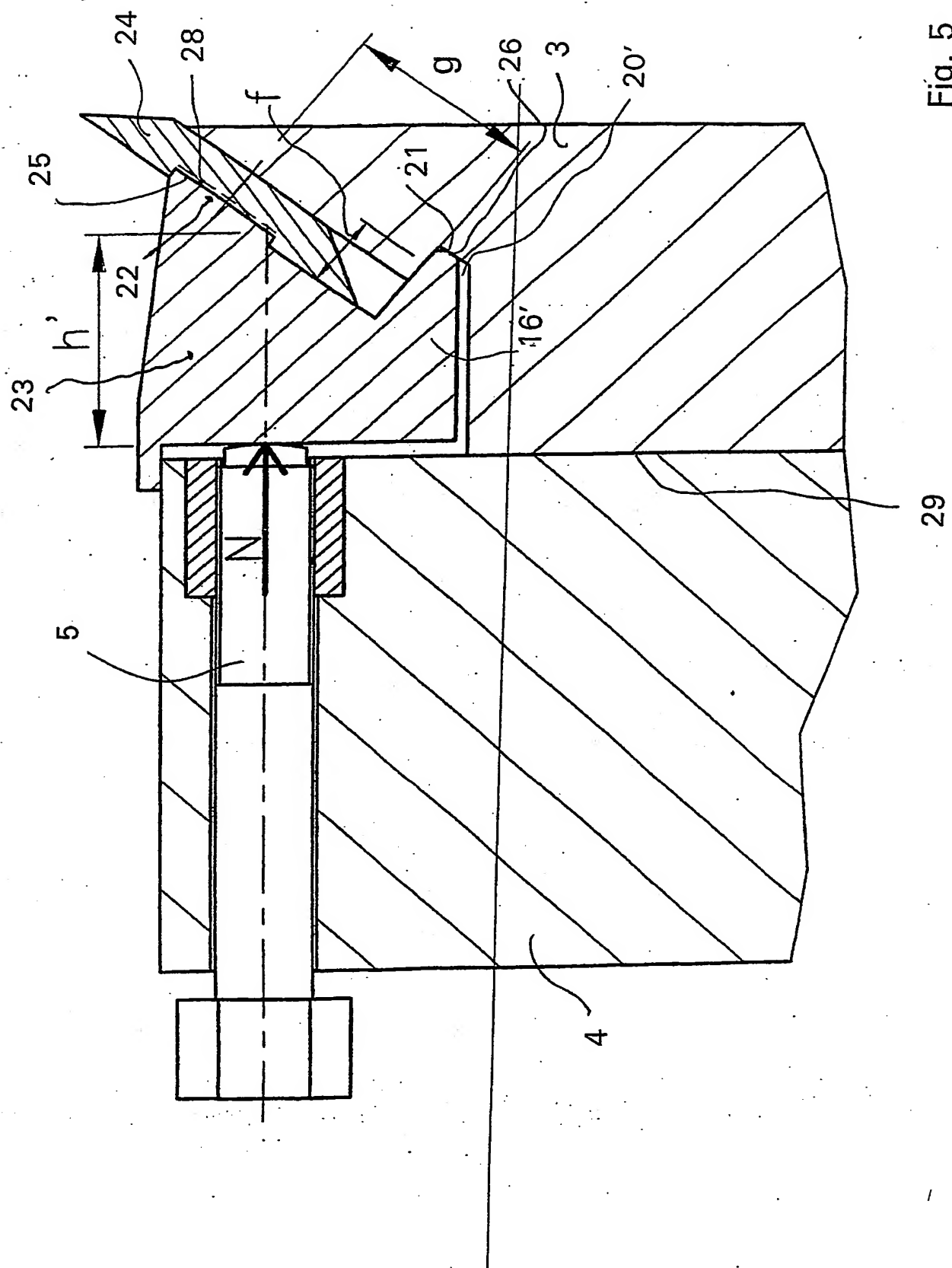


Fig. 4



## INTERNATIONAL SEARCH REPORT

International Application No.

PCT/FI 03/00495

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B27L 11/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B27L, B27G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9958310 A1 (SUNDS DEFIBRATOR WOODHANDLING OY), 18 November 1999 (18.11.99) --	1-5
A	US 5660218 A (ARVO JONKKA), 26 August 1997 (26.08.97) -----	1-5

☐

Further documents are listed in the continuation of Box C.

☒

See patent family annex.

## \* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search

30 Sept 2003

Date of mailing of the international search report

06-10-2003

Name and mailing address of the ISA/

Swedish Patent Office

Box 5055, S-102 42 STOCKHOLM

Facsimile No. +46 8 666 02 86

Authorized officer

Eddy Leopold/ELY

Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT  
Information on patent family members

06/09/03

International Application No.

PCT/FI 03/00495

Patent document cited in search report			Publication date	Patent family member(s)		Publication date
WO	9958310	A1	18/11/99	AT	243609 T	15/07/03
				BR	9910091 A	09/10/01
				CA	2331731 A	18/11/99
				DE	69909093 D	00/00/00
				EP	1094923 A,B	02/05/01
				FI	104157 B	00/00/00
				FI	981033 D	00/00/00
				US	6484770 B	26/11/02
				ZA	200006168 A	23/05/01
<hr/>						
US	5660218	A	26/08/97	AT	166019 T	15/05/98
				CA	2165670 A,C	19/01/95
				DE	69410271 D,T	26/11/98
				EP	0707529 A,B	24/04/96
				SE	0707529 T3	
				ES	2118419 T	16/09/98
				FI	933131 D	00/00/00
				FI	956082 A	18/12/95
				NO	303330 B	29/06/98
				NO	960055 A	05/01/96
WO	9501857 A	19/01/95				
<hr/>						

**This Page is Inserted by IFW Indexing and Scanning  
Operations and is not part of the Official Record**

**BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☒ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** \_\_\_\_\_

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.**